(See disclaimer on last page for reference material)

**Introduction:**

The handheld 3D scanner is a "Light Pattern Scanner." It projects a predetermined light pattern onto the object being scanned and reads the return values to establish geometry. It is able to detect edges, curves, and darker patterns or designs on the object's surface. The 3D scanner software used is VX Elements 5.

NOTE: Initial scan files will be large (1+ GB range), so make sure you have sufficient portable data storage on hand to save the file to after scanning.

ME Dept. Individuals with access to scanner:

1. Becky Schoenberg – ME Dept. Administrative Assistant
2. IEW Grad. Student
3. Dr. Odom
4. Bill Magnie - Shop Supervisor

**Rules for Using the 3D Scanner:**

1. If the scanner is not in your hands, it needs to be placed on a flat surface at least 6 inches away from any edges.
2. When moving the scanner, make sure it is placed securely in the case and the locks are secure.
3. When you are finished using the scanner, it needs to be given to either Dr. Odom or Brian Hanson

**Scanner Set-up:**

1. Set up laptop and 3D scanner on work surface. Connect 3D scanner power/data cable to computer and power outlet, then connect to 3D scanner. The scanner should flash when plugged into the USB cable. Also be sure to connect the laptop power supply to power outlet, and connect to laptop.

2. Turn on laptop, and start up VX Elements 5 software from the laptop's desktop. Apply positioning targets to the object to be scanned. Make sure that at least 2 targets are visible from any potential scanning viewpoint. The targets are not free ($0.25 each) so save them if possible, and avoid damaging the front facing or the adhesive backing.

NOTE: Leave laptop plugged into power outlet for the duration of the scan. If you do not leave it plugged in, it could turn off during a scan and you will lose your progress.

NOTE: Objects with matte materials will scan the best. Dark materials and reflective materials may not be received properly.

NOTE: A turntable is recommended to more easily rotate the object during the scan. Suspending the object is a viable alternative to a turntable.

**Calibration:**

1. Open the calibration plate and set it on a stable surface.
2. Do not touch the calibration plate surface, as the oils from your skin can damage it and affect the calibration.
3. Click "Calibration" at the top of the screen.
4. Point the scanner at the calibration plate and begin scanning. Slowly rotate the scanner and pull the scanner away from the calibration plate as directed on the VX Elements program.
5. Close the calibration plate when you are finished, and return it to the carrying case.
6. You are now ready to scan your object.

- See the Calibration Tutorial here: https://youtu.be/4cdUKqbjg7k
    - Calibration Tutorial Description: To calibrate the scanner, use the calibration plate provided in the carrying case. Hold down the trigger and align the handheld scanner with the dots on the calibration plate. Tilt the scanner up or down to align it with the computer. Then slowly begin backing it up until the full board is shown on the screen. When done properly, the handheld scanner should now be calibrated and synchronized with the software.

**Scanning the Object:**

NOTE: The scanner reads the object from the lens below the pistol grip, not above. This is counter-intuitive, so remember to keep track of where the lens is reading.

Prior to Scanning: Place positioning targets on the part that you wish to scan. Make sure to place them at places where there are drastic changes in the geometry, such as curves or dips, and place them so that two dots are always visible from any angle. (See pictures for reference on WIKI Page)

1. To begin scanning, hold down the trigger on the pistol grip. Releasing the trigger will stop the scan, but not cancel it. While holding the trigger down and scanning, rotate the object slowly so that the scanner can scan all faces of the object; making sure to keep two positioning targets in view of the scanner at all times.
2. While scanning, keep track of the distance gauge on the software window, or on the top of the pistol grip. The top light means the scanner is too close, the bottom indicates it is too far, and the middle light indicates a proper distance from the object.
3. Slow, smooth movements will allow the scanner to achieve the most accurate levels of detail, and is most effective in preventing holes in the resulting object mesh.
4. When resuming a scan, make sure to align the 3D scanner to the positioning targets last recorded in the software window. The software will not allow you to resume scanning while pointed at a section of the part not previously scanned.

- See the Begin Scanning Tutorial here: https://youtu.be/rfuDls9KGqI
    - Begin Scanning Tutorial Description: At this point we are ready to scan. It is recommended you find a turntable, or similar setup that will allow you to easily rotate what you want to scan, or have sufficient room to walk around it. Hit the "scan" button, and start scanning. This is the trigger and there are three lights on the top, one light says you're too close, the other says you're too far away, and the middle say you're good. After holding the trigger, on the left side on the screen, a bar will appear and does the same thing as the lights on top of the scanner.

- See the Resume Scan Tutorial here: https://youtu.be/_JN630MEUIs
    - Resume Scan Tutorial Description: When you stop scanning and you want to resume, you have to hit the "Resume scan" button. Then find the last spot that was scanned on the software to resume scanning. The software needs to resume from the last recorded position. You need to look for it until you get the green square on the screen. A red square means it's not the right spot.

- See the Rendered Model Example here: https://youtu.be/xyvbhtO9eGM
    - Rendered Model Example Description: This video shows the rendered scan of the Thermos on the computer screen.

- See the Dot Free Scan Example here: https://youtu.be/-KsENmlBEnA
    - Dot Free Scan example Description: Normally the positioning targets help the scanner to read and record geometries that are symmetrical or that lack distinct

texture. In this case, the scanner is able to scan the notebook without positioning targets due to the unique shape and texture.

**Post-scan Editing:**

1. Click the Edit Scan button on the top toolbar. If a floor was scanned that is not desired in the final product, remove as much as possible first. Select the desired surface to remove and press DELETE. Remember to hold down CTRL while selecting multiple surfaces.
2. After removing the floor surface, exit Edit Scan mode and create the mesh of the object by selecting the Create Mesh tool from the top toolbar. By right-clicking the mesh on the navigation tree to the left of the screen, you can duplicate the mesh to preserve a version before any future edits.

NOTE: Checking the box next to the item in the navigation tree toggles visibility of that item in the interface. Leave only the mesh being edited visible.

3. Use the Clean Mesh tool from the top toolbar to remove some of the isolated pieces of the scan.
4. Fill holes in the scan with the "Hole Filler" tool. Start with the "Adaptive" filling method. Sometimes it will not work and the "Curvature" or "Flat" option will need to be used instead.

NOTE: It is highly recommended to exit and re-enter the "Hole Filler" tool after every hole. Otherwise clicking "Undo" will reset every action since entering the tool.

5. The "Bridging" tool can be used when a large hole needs to be divided so that the software can better fill it with the correct geometry. This tool is accessed from the left side of the "Hole Filler" menu. It works by selecting two edges and a middle point on each side of the space to be bridged.
6. Smoothing tools and others can be used.
7. Any holes, isolated pieces, singularities, or discontinuities will cause problems when trying to export the mesh to SolidWorks so try to catch them all in advance.

- See the Mesh Creation Tutorial here: https://youtu.be/tMSPs7G2IaY
    - Mesh Creation Tutorial Description: You need to hold down control when you are selecting polygons on the scan. Holding down control will allow you to make further selections and adjustments to the highlighted area. The first step is to remove the floor surrounding the model. Now we can create the mesh by clicking the "Create Mesh" button. After creating the mesh, it's a good idea to make a copy of the original mesh so you have a backup in case something goes

wrong. Deselect the original mesh and texture to see only the copy. Now we need to remove the parts that are floating. Clicking "Clean Mesh" fixes up some of the scan, and the rest can be cleaned using "Isolated Patches" and increasing the sensitivity. This should delete everything but the main part.

- See the "Hole Filler" Tutorial here: https://youtu.be/eNY42QOIaNI
    - "Hole Filler" Tutorial Description: Now we need to fill in holes on the scan. You want to start with "Adaptive Filling" at the beginning and see if that works. If it doesn't work, like this one, try "Curvature" or "Flat" instead to see if that works. In this case "Curvature" worked the best. Remember to close out of the Hole Filler every time you make a change. If you make multiple changes without closing the Hole Filler and something goes wrong, you will have to redo everything. This will cause the program to "Error Out" or Crash.

- See the Bridging Tutorial here: https://youtu.be/ovExdFw-6aM
    - Bridging Tutorial Description: In this case we have a hole that has an ugly error in it. So what we do is select the polygons surrounding it that we want to delete in order to create a more controlled gap to fill in with the "Hole Filler". Remember to deselect polygons that you don't want to delete, or you may delete other parts of your model. The higher the quality of your scan, the less time you will need to spend getting it cleaned up. In this case, we will need to use the Bridge tool to separate this hole into more manageable pieces for the program to process. You need to pick a first point, a last point, and a middle point on both sides of the gap to define the bridge. Then use the "Hole Filler" tool to fill in the smaller holes. Repeat the process of bridging as needed until the program can fill in the holes.

**Exporting the Scan:**

NOTE: DO NOT use Export to SolidWorks! Doing so will create an image of the scan that cannot be edited in SolidWorks.

1. Decimate the mesh to reduce the number of triangles. This can be scaled by percentage or by entering in a desired number. 20,000 is the absolute maximum SolidWorks can handle. Check the max deviation box and enter a value (1mm works).
2. Click the "Export" button on top toolbar and select the "Mesh" option.
3. Save as STL file type.

- See the Decimation Tutorial here: https://youtu.be/p2jj7DPcvqo

  - Decimation Tutorial Description: Now we need to use the "Decimate" tool, found here. Right now we have 35,000 triangles, which needs to be reduced to less than 20,000 for it to work in SolidWorks. 10,000 is ideal. You can do this based on the percentage, or using the slider and checking the number again. It is important to turn on the maximum deviation of one millimeter to prevent deviation from the scanned shape. Click "Apply". The new mesh should look very similar to the original shape. The program has smoothing options if the mesh is rough.

- See the Exporting Tutorial here: https://youtu.be/TNHzyLULBUg
  - Exporting Tutorial Description: Once you have a mesh you are satisfied with, you can export it for use in Solidworks. Do this by selecting the mesh, clicking "Export", then click "Mesh", and save it as an .STL file. Remember not to click "Export to Solidworks" because it will generate a graphic model that cannot be edited in SolidWorks.

**Creators of this Tutorial:**

3D Handheld Scanner Team – CATIA Course, Fall 2016

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*** For reference images and videos, please see the UIdaho Wiki Page dedicated to this Tutorial found here: http://mindworks.shoutwiki.com/wiki/3D_Scanner